ARCO-25,200; DP 50-06-1641C

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

The Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the continuation patent application of:

Inventor: Steve Ingistov

For: "TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL"

Our Docket No.: ARCO-25,195

I hereby certify that this paper and fee are being deposited with the United States Postal Service as Express Mail Post Office to Addressee under 37 CFR §1.10 on the date indicated below and is addressed to Box Patent Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

Express Mail Label No. EL212634615US

Date of Deposit: 4/9/99

F. Lindsey Scott
Name of Person Mailing Paper and Fee

F. Lindsey Scott
Signature of Person Mailing Paper and Fee

Also Enclosed:

Copy of prior application
Copy of Declaration and Power of Attorney
Preliminary Amendment
Information Disclosure Statement with references
Revocation and Power of Attorney
Appointment of Associate Attorney

	Number Filed		Number Extra		Rate		Basic Fee
							$760.00
Total Claims	20	Minus 20 =	-0-	X	$18	=	-0-
Independent Claims	3	Minus 3 =	-0-	X	$78	=	-0-
			TOTAL FEE FOR FILING			=	$760.00

Please charge Deposit Account No. 01-2720 in the amount of $760.00.

For the entire pendency of this application, the Commissioner is hereby authorized to charge all fees which may be required, or credit any overpayment to Deposit Account No.01-2720.

The Patent and Trademark Office is requested to direct all mail and telephone calls to:

The Law Office of F. Lindsey Scott
14651 Dallas, Parkway, Suite 102
Dallas, Texas 75240-7477

F. Lindsey Scott
(972) 661-0102, Ext. 1

Respectfully submitted

Michael W. Piper
Attorney for Applicant
Registration No. 39,800

FLS:jp

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Docket No. ARCO-25,200; DP 50-06-1641C

Anticipated Classification of this application:

Class _____ Subclass _____

Prior application:

Examiner J. Kwon

Art Unit 3401

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

This is a request for filing a ☒ continuation ☐ divisional application under 37 CFR 1.53(b), of pending prior application serial no. 08/892,738, filed on July 15, 1997 of Steve Ingistov (inventor currently of record in prior application) for "Turbine Power Plant Having Minimal-Contact Brush Seal Augmented Labyrinth Seal".

1. ☒ Enclosed is a copy of the prior application, including the oath or declaration as originally filed.

☒ I hereby verify that the attached papers are a true copy of what is shown in my records to be the above-identified prior application, including the oath or declaration.

The copy of the papers of prior application as filed which are attached are as follows:

☒ 13 page(s) of specification

☒ 7 page(s) of claims

☒ 1 page(s) of abstract

☒ 2 sheet(s) of drawing (Also complete 7 below)

☒ 4 page(s) of declaration and power of attorney

☒ My records reflect that the original signed declaration showing applicant's signature was filed on July 29, 1996.

☒ An information disclosure statement is submitted herewith.

2. ☒ The filing fee is calculated below:

CLAIMS AS FILED IN THE PRIOR APPLICATION, LESS ANY CLAIMS CANCELED BELOW

For	Number filed		Number extra		Rate	Basic Fee $760.00
Total claims	20	-	20	= -0-	x $ 18 =	$ -0-
Independent claims	3	-	3	= -0-	x 78 =	-0-
Multiple dependent claims, if any					x 260 =	-0-
Total filing fee						$760.00

3. ☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Account No. 01-2720 for filing fees only. A duplicate copy of this sheet is enclosed.

4. ☐ A check in the amount of $_____ is enclosed.

5. ☐ Cancel in this application original claims _____ of the prior application before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

6. ☒ Amend the specification by inserting before the first line the sentence: --- This is a ☒ continuation, ☐ division, of application serial no. 08/892,738 filed on July 15, 1997, which is a division of application serial no. 08/656,564 filed on May 31, 1996. ---

7a. ☐ Transfer the drawings from the prior application to this application and abandon said prior application as of the filing date accorded this application. A duplicate copy of this sheet is enclosed for filing in the prior application file. (May only be used if signed by person authorized by Section 1.138 and before payment of base issue fee.)

7b. ☐ New formal drawings are enclosed.

7c. ☒ One copy of informal drawings is enclosed.

8. ☐ Priority of application serial no. _____ filed on _____ in ____(country)_____ is claimed under U.S.C. 119.

☐ The certified copy has been filed in prior application serial no . _____ _____, filed _____.

9. ☒ The prior application is assigned of record to Watson Cogeneration Company.

10. ☒ The power of attorney in the prior application is to:

Jeffrey G. Sheldon, Reg. No. 27,953
Denton L. Anderson, Reg. No. 30,153
Danton K. Mak, Reg. No. 31,695
Stephen R. Seccombe, Reg. No. 31,136

a. ☒ The power appears in the original papers in the prior application.

b. ☐ Since the power does not appear in the original papers, a copy of the power in the prior application is enclosed.

c. ☒ The power of attorney was revoked and Albert C. Metrailer, Registration No. 22,714; Steven J. Funk, Registration No. 35,875; John L. Wood, Registration No. 32,183; Rodney B. Carroll, Registration No. 39,624; and F. Lindsey Scott, Registration No. 26,230, were appointed as attorneys with full power of substitution and revocation to prosecute said application and transact all business in the Patent and Trademark Office in connection with said applciation and to receive any patent issuing thereon in a Revocation and Power of Attorney filed in U.S. 08/892,738 April 8, 1999. Michael W. Piper, Registration No. 39,800 was appointed an Associate Attorney in an Appointment of Associate Attorney filed in U.S. 08/892,738 April 8, 1999.

d. ☒ Address all future communications to F. Lindsey Scott, Suite 102, 14651 Dallas Parkway, Dallas, Texas 75240-7477.

11. ☒ A preliminary amendment is enclosed (Claims added by this amendment have been properly numbered consecutively beginning with the number text following the highest numbered original claim in the prior application.

The undersigned declares further that all statements made herein of his own knowledge are true and that all statement made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereof.

Michael W. Piper
Type or print name of person signing

4/9/99
(date)

Michael W. Piper
(signature)

Address of signature:

Atlantic Richfield Company

2300 West Plano Parkway

Plano, Texas 75075

☐ Inventor(s)

☐ Assignee of complete interest

☒ Attorney or agent of record

☐ Filed under Section 1.34(a)

CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this 37 CFR 1.60 request and these documents referred to as attached therein are being deposited with the United States Postal Service on this date April 9, 1999 in an envelope as "Express Mail Post Office to Addressee" service under 37 CFR 1.10, Mailing Label Number EL212634615US addressed to the: Commissioner of Patents and Trademarks, Washington, D.C. 20231.

F. Lindsey Scott
(Type/print name of person mailing paper)

F. Lindsey Scott
(Signature of person mailing paper)

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DOCKET NO.: ARCO-25,200; DP 50-06-1651C PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re prior application of: Steve Ingistov

Prior Serial No. : 08/892,738

Filed: July 15, 1997

Group Art Unit: 3401

Examiner: J. Kwon

Title : TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

AMENDMENT TRANSMITTAL LETTER

Transmitted herewith is a Preliminary Amendment for filing in the above-identified continuation patent application.

The fee has been calculated as shown below:

CLAIMS AS AMENDED

	Number After Amendment:	Number Previously Paid For		Number Extra		Rate:		Fee:
Total Claims	20	Minus 20	=	-0-	x	$18	=	-0-
Independent Claims	6	Minus 3	=	3	x	$78	=	$234.00
		TOTAL FEE FOR FILING						$234.00

Please charge the filing fee of $234.00 to Deposit Account No. 01-2720.

For the entire pendancy of this application, the Commissioner is hereby authorized to charge all fees which may be required, or credit any overpayment to Deposit Account No. 01-2720.

Respectfully submitted,

Michael W. Piper
Registration No. 39,800
Attorney for Applicant

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DOCKET NO.: ARCO-25,200; DP 50-06-1651C PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re prior application of: Steve Ingistov

Prior Serial No. : 08/892,738

Filed: July 15, 1997

Group Art Unit: 3401

Examiner: J. Kwon

Title : TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

PRELIMINARY AMENDMENT

The following Preliminary Amendment is submitted in the subject application.

IN THE SPECIFICATION

At page 1, the first line in the third paragraph is amended to read "Leakage in excess [if] of a predetermined amount that".

At page 2, in the second line, the word "due" is added after the word "seal".

At page 8, in the fifth and seventh lines, the numeral "18" is changed to be the numeral "24". The eighteenth line is revised to read as follows: "32 that also supports a final stator member [34] 17S of the".

At page 9, in the fourth and fifth lines from the bottom of the page, the numeral "40" is deleted.

On page 10, in line 2, the numeral "24" is changed to the numeral "42". In the second line of the paragraph beginning near the top of page 10, the numeral "40" is deleted; and in the eleventh line from the bottom of the page, the numeral "40" is deleted.

On page 12, in the fifth and sixth lines of the paragraph beginning near the top of page 12, the numeral "70" is deleted; and in the eighth line from the bottom of the page, the numeral "40" is deleted.

On page 13, in the seventh line, after the word "that", the article "a" is added.

IN THE CLAIMS

Please cancel Claims 1-20.

Please add new Claims 21-31 as follows.

21. A stationary gas turbine engine for a power plant, comprising:

(a) a multistage axial compressor, the compressor having a rotor, the rotor having a cylindrical land region downstream of a last-stage of the compressor, the land region having an outside diameter D;

(b) a turbine shaft-coupled to the rotor of the compressor;

(c) a combustor fluid coupled between the compressor and the turbine;

(d) a stationary inner barrel member downstream of the compressor, air flowing from the compressor to the combustor passing outside of the inner barrel member, a chamber within the inner barrel member forming a main passage and containing a labyrinth seal comprising at least one knife-edge member positioned on the barrel member for controlling air leakage through the labyrinth for cooling air from the compressor, the cooling air flowing from the chamber and being mixed with combustion gases upstream of the turbine; and

(e) a brush seal positioned on the barrel member and upstream from the labyrinth seal for restricting air passage into the chamber from the compressor, the brush seal comprising:

(i) a ring-shaped holder;

(ii) a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder; and

(iii) the holder being fastened to the inner barrel member,

wherein, when the power plant is inactive, the bristles have an ambient temperature clearance of not less than 0.015 percent of the diameter D from the land region of the rotor and whereby air flow into the compressor is impeded.

22. The engine of Claim 21, further comprising a barrel passage extending through one wall of the inner barrel for passing air therethrough downstream of the brush seal, thereby altering the flow of cooling air from the chamber to be mixed with the combustion gases upstream of the turbine.

23. The engine of Claim 22, further comprising a structure for restricting the barrel passage.

24. The engine of Claim 21, further comprising an insert ring connecting segments of the inner barrel member, the insert ring being located proximate the land region of the rotor, the holder being fastened to the insert ring by a plurality of threaded fasteners.

25. The engine of Claim 24, wherein the brush seal, including the holder thereof is segmented for facilitating assembly with the insert ring.

26. In a turbine power plant having a multistage axial compressor, a turbine shaft-coupled to a rotor of the compressor, a combustor fluid-coupled between the compressor and the turbine, and a labyrinth seal between the rotor and a stationary inner barrel member, the rotor having a cylindrical land region of diameter D, the improvement comprising a brush seal connected to the inner barrel

and augmenting the labyrinth seal, being fluid connected in series therewith, the brush seal comprising:

(a) a ring-shaped holder;

(b) a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder; and

(c) the holder being fastened to the inner barrel member,

wherein, when the power plant is inactive, the bristles have an ambient temperature clearance of not less than 0.015 percent of the diameter D from the land region of the rotor.

27. A method for controlling cooling air flow in a turbine power plant having a multistage axial compressor, a turbine shaft-coupled to a rotor of the compressor, a combustor fluid-coupled between the compressor and the turbine, and a labyrinth seal between the rotor and a stationary inner barrel member, the rotor having a cylindrical land region of diameter D, comprising the steps of:

(a) providing a brush seal having a ring-shaped holder, a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder;

(b) connecting the brush seal in augmenting relation to the labyrinth seal; and

(c) spacing the bristle members from the land region of the rotor by an ambient temperature clearance of not less than 0.015 percent of the diameter D when the power plant is inactive.

28. The method of Claim 27, wherein the power plant includes an insert ring fastened to the inner barrel member in axially spaced relation to a portion of the rotor member, the method comprising the further steps of:

(a) removing the insert ring from the inner barrel member;

(b) providing an adapter ring;

(c) mounting the brush seal to the adapter ring; and

(d) fastening the adapter ring to the inner barrel member in place of the insert ring.

29. The method of Claim 28, wherein the step of providing the adapter ring comprises the step of modifying the insert ring.

30. The engine of Claim 22, wherein the barrel passage is one of a plurality of barrel passages.

31. A method for generating electrical power comprising the steps of:

(a) providing the improved power plant of Claim 11; and

(b) monitoring an operating parameter of the power plant.

Please add new Claims 32-40 as follows.

32. A refurbished gas turbine engine component having at least one knife edge seal for inhibiting air leakage through an intercomponent gap between the component and a second component, the refurbished component characterized by:

a brush seal mounted on the refurbished component in tandem with the knife edge seal, the bristles of the brush seal extending toward the second component for impeding the leakage of air through the intercomponent gap.

33. The refurbished component of Claim 32 characterized in that the component comprises two component segments, the brush seal is also segmented and the brush seal segments are mounted in a circumferentially extending groove so that the seal is installable and removable by

separating the component segments and sliding the brush seal segments circumferentially in the groove.

34. A method of improving the air sealing effectiveness between a rotating component and a nonrotating component in a turbine engine, the rotating and nonrotating components being separated by a gap with knife edge seals extending across the gap to inhibit leakage of air therethrough, the method characterized by:

providing a brush seal;

reconfiguring the nonrotating component to provide means for receiving and retaining the brush seal in tandem with the knife edge seals; and

installing the brush seal so that the seal bristles extend toward the rotating component to impede the flow of air through the gap, the brush seal being retained by the receiving and retaining means.

35. The method of Claim 34 wherein the nonrotating component is hollow and substantially cylindrical and has a wall thickness and a face, the method characterized in that the step of reconfiguring the nonrotating component includes:

creating a capture slot in the faced of the nonrotating component for radially retaining the brush seal; and

attaching a retainer to the nonrotating component so that the retainer cooperates with the face to axially trap the brush seal.

36. The method of Claim 35 characterized in that the reconfiguring step includes reducing the wall thickness by a predefined amount in the vicinity of the face to form a seal seat and accommodate the radial dimension of the brush seal.

37. The method of Claim 35 characterized in that the reconfiguring step regulates the axial length of the nonrotating component.

38. The method of Claim 34 wherein the brush seal is a multilayered brush seal.

39. The method of Claim 34 wherein the nonrotating component comprises upper and lower component segments each component segment subtending approximately 180 degrees of arc, and the brush seal comprises an upper brush seal segment subtending approximately 180 degrees of arc and one or more lower brush seal segments, the lower brush seal segments collectively subtending approximately 180 degrees of arc.

40. A method of improving the air sealing effectiveness between a rotating component and a nonrotating component in a turbine engine, the nonrotating component being hollow and substantially cylindrical and having a wall thickness and a face, the rotating and nonrotating components being separated by a gap with knife edge seals extending across the gap to inhibit leakage of air therethrough, the method characterized by:

reconfiguring the nonrotating component by reducing its axial length by a predetermined amount and reducing its wall thickness in the vicinity of the face by a predefined amount whereby a seal seat is formed;

creating an axially and circumferentially extending capture slot in the face of the nonrotating component;

attaching a retainer to the face so that the retainer cooperates with the face and the seal seat to define a circumferentially extending groove; and

installing a brush seal in the groove so that the bristles of the seal extend toward the rotating component to impede the flow of air through the gap;

the brush seal being radially retained by the capture slot and the seal seat and axially retained by the retaining ring and the face.

COMMENTS

New Claims 21-31 represent the non-allowed claims from U.S. Serial No. 08/892,738 which do not include features related to the admission of cooling air into the barrel of the turbine engine in addition to that passing the brush seal. The claims which include this feature have been allowed. Claim 21 has been amended slightly by comparison to Claim 1. The only reference cited against the remaining claims was U.S. Patent 5,630,590 (the '590 Patent), issued May 20, 1997 to Joseph P. Bouchard and Merrell W. Long and assigned on its face to United Technologies Corporation. The '590 Patent was filed March 26, 1996.

The parent application to the subject application was filed as U.S. Serial Number 08/656,564 May 3, 1996.

Under 37 CFR 1.608(a) "When the effective filing date of an application is three months or less after the effective filing date of a patent, before an interference will be declared, either the applicant or applicant's attorney or agent of record shall file a statement alleging that there is a basis upon which the applicant is entitled to a judgment relative to the patentee. 37 CFR 1.607(a) provides that:

"(a) An applicant may seek to have an interference declared between an application and an unexpired patent by,

(1) Identifying the patent,

(2) Presenting a proposed count,

(3) Identifying at least one claim in the patent corresponding to the proposed count,

(4) Presenting at least one claim corresponding to the proposed count, and

(5) Applying to the terms of any application claim,

(i) Identified as corresponding to the count, and

(ii) Not previously in the application to the disclosure of the application.

(6) Explaining how the requirements of 35 U.S.C. 135(b) are met, if the claim presented or identified under paragraph (a)(4) of this section was not present in the application until more than one year after the issue date of the patent."

Even a cursory review of the drawings of the '590 Patent and Applicant's drawings reveals that the invention claimed is the same.

It is proposed that an acceptable count for this interference is as follows.

COUNT

A gas turbine engine, the first component having at least one knife edge seal for inhibiting air leakage through an intercomponent gap between the first component and the second component, the first component characterized by a brush seal mounted on the first component in series with the knife edge seal, the bristles of the brush seal extending toward the second component for impeding the leakage of air through the inner-component gap.

This proposed Count is substantially Claim 1 of the '590 Patent, restated to cover gas turbines generally, rather than only refurbished gas turbines.

This Count is considered suitable to the Applicant. It is considered that Applicant's Claim 21 corresponds to this Count and claims each element recited in the Count. In Applicant's Claim 21, a stationary gas turbine engine is claimed. The engine includes a rotor having a cylindrical land region which corresponds to the second component in the '590 Patent and a stationary inner barrel downstream of the compressor which corresponds to the first component in the '590 Patent claim. Applicant's claim includes a labyrinth seal including at least one knife-edge seal and a brush seal, both of which are mounted on the first component for controlling passage of air between the two components. Accordingly, it is clear that all elements of the '590 Patent, Claim 1, are included in Applicant's Claim 21 as presently pending.

Applicant considers that the invention claimed in the '590 Patent is the same invention claimed in the subject application. Accordingly, it is believed clear that Applicant's claimed invention and that claimed in the '590 Patent are the same invention.

STATEMENT

It is considered that the subject application claims the same invention as the '590 Patent, as discussed above. Under 37 CFR 1.608(a), a statement by Applicant's attorney is required to initiate an interference when the effective filing date of an application is less than three months after the effective filing date of the patent. The subject application has an effective filing date of May 31, 1996 and the '590 Patent has an effective filing date of March 26, 1996--less than three months before the effective filing date of this application. Applicant's attorney hereby states that, upon investigation, there is a basis in Applicant's attorney's opinion, upon which the Applicant is entitled to a judgment relative to the patentee in an interference.

It is hereby respectfully requested that an interference be declared between the subject application and U.S. Patent 5,630,590.

Accordingly, it is respectfully requested that the Examiner determine that an interference should be declared and that the Examiner prepare and forward interference papers to the Board as provided in 37 CFR 1.609.

Respectfully submitted,

F. Lindsey Scott
Registration No. 26,230
Attorney for Applicant

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TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL

by

Steve Ingistov

BACKGROUND

The present invention relates to turbine power plants and more particularly to large, stationary turbine power generators of the type used for utility services.

A typical stationary turbine power plant, known as Model Series 7001 simple cycle, single shaft, heavy duty gas turbine (Frame-7 machine), is available from General Electric of Schenectady, NY. In this and similar gas turbines, a seal is located between an axial compressor rotor and a stationary inner barrel member, a chamber within the inner barrel member being supplied with cooling air from the last stage of the compressor by a controlled amount of leakage through the seal. The cooling air is then utilized for cooling of a first turbine stage of the machine. A set of rotor bearings is located in the cavity.

Leakage in excess if a predetermined amount that is required for cooling of the turbine becomes parasitic and contributes to inefficiency of the machine. This is a serious problem in turbine power plants of the prior art, in that the labyrinth seals degrade in operation because of thermal expansions and other factors that cause knife-edge members and adjacent rotating elements of the seals to be worn away quickly, particularly during shut-down sequences. This is caused, for example, by shrinkage of the inner

barrel member being more rapid than shrinkage of the rotor at the seal to the rotor being more massive. Thus in the frame-7 machines, the bypass air flow increases to approximately 100,000 lb/hr from the 30,000 lb/hr that is considered optimal. Consequently, there is a loss of power that is believed to be between 1.5 MW and 3.0 MW.

Brush seals for gas-turbine engines are known, being disclosed, for example in "Brush Seals," *Directions*, Sept. 1993. As disclosed therein, a brush seal consists of densely packed metallic bristles that are welded between a down-stream backing plate and an up-stream side plate. In a typical round seal for aircraft turbine applications, the plates are ring-shaped, the bristles extending radially inwardly at a trailing lay angle and making an interference contact with a rotor element, so that the bristles become curved and follow the rotor as it grows and shrinks during engine operation.

Brush seals have not been applied to existing large power plant turbines for a number of reasons. For example, the existing rotor components, being made from elements of low carbon steel alloys that are selected for certain thermal expansion properties, are believed to be unsuitable as wear surfaces for contact by the bristles, particularly during the extended operation cycles that are demanded of stationary power plants. Suitable hardening of applicable compressor rotor members is believed to be prohibitively expensive, particularly in existing equipment.

Thus there is a need for an improved rotor seal for large stationary plants, that overcomes the disadvantages of the prior art.

SUMMARY

The present invention meets this need by providing a turbine power plant with a combination brush and labyrinth compressor seal wherein the brush seal operates in a non-contact mode following start-up. In one aspect of the invention, a stationary gas turbine engine for the power plant includes a multistage axial compressor that has a rotor having a cylindrical land region downstream of a last-stage of the compressor, the land region having an outside diameter D; a turbine shaft-coupled to the rotor of the compressor; a combustor fluid-coupled between the compressor and the turbine; a stationary inner barrel downstream of the compressor, air flowing from the compressor to the combustor passing outside of the inner barrel, a chamber within the inner barrel forming a passage for cooling air from the compressor, the cooling air flowing from the chamber and being mixed with combustion gases upstream of the turbine; a brush seal for restricting air passage into the chamber from the compressor, the brush seal including a ring-shaped holder; a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder; and means for fastening the holder to the inner barrel, wherein, when the power plant is inactive, the bristles have an ambient temperature clearance of not less than 0.015 percent of the diameter D from the land region of the rotor.

The engine can further include means for selectively altering the flow of cooling air from the chamber, including a passage extending through one wall of the inner barrel; means for connecting the fluid port to an auxiliary source of pressure air external of the inner barrel, whereby pressure air from the auxiliary source

augments the flow of cooling air from the chamber; and means for changeably restricting flow of pressure air into the chamber from the auxiliary source of pressure air. The compressor can provide at least a portion of the auxiliary source of pressure air. The means for changeably restricting can include means for removably mounting a device being a plug or a jet in the passage.

Preferably the means for selectively altering the flow of cooling air also includes a valve for adjustably restricting flow of pressure air into the chamber from the auxiliary source of pressure air; and means for monitoring an operating parameter of the engine, the operating parameter being responsive to the flow of cooling air from the chamber. The valve is preferably a calibrated needle valve for facilitating repeatable control of the cooling flow. The means for monitoring can include a temperature sensor for indicating temperatures within the chamber. The engine can also have an outer barrel surrounding the inner barrel and including a fluid port extending radially through one wall thereof, the gas flow from the compressor to the combustor passing between the outer barrel and the inner barrel, the means for connecting the passage including a fluid conduit connected between the passage and the fluid port, and means for connecting the auxiliary source of pressure air to the fluid port external of the outer barrel.

The engine can further include an insert ring connecting segments of the inner barrel, the insert ring being located proximate the land region of the rotor, the means for fastening the brush seal to the inner barrel including the holder being fastened to the insert ring by a plurality of threaded fasteners. Preferably the brush seal, including the holder thereof, is segmented for facilitating assembly with the insert ring.

In another aspect of the invention, a turbine power plant improvement includes a brush seal connected to a stationary barrel member between an axial compressor outlet and a cavity within the barrel member for augmenting a labyrinth seal that limits the flow of cooling air into the cavity, the brush seal having a ring-shaped holder, a multiplicity of bristle members being rigidly anchored to the holder and extending radially inwardly therefrom toward a rotor land region, wherein the bristles have an ambient temperature clearance of not less than 0.015 percent of a diameter D of the land region when the power plant is inactive.

In a further aspect of the invention, a method for controlling cooling air flow in a turbine power plant having a multistage axial compressor, a turbine shaft-coupled to a rotor of the compressor, a combustor fluid coupled between the compressor and the turbine, and a labyrinth seal between the rotor and a stationary inner barrel member, the rotor having a cylindrical land region of diameter D, includes the steps of:

(a) providing a brush seal having a ring-shaped holder, a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder;

(b) connecting the brush seal in augmenting relation to the labyrinth seal; and

(c) spacing the bristle members from the land region of the rotor by an ambient temperature clearance of not less than 0.015 percent of the diameter D when the power plant is inactive.

The power plant can include an insert ring fastened to the inner barrel in axially spaced relation to a portion of the rotor member, the method including the further steps of:

(a) removing the insert ring from the inner barrel member;

(b) providing an adapter ring;

(c) mounting the brush seal to the adapter ring; and

(d) fastening the adapter ring to the inner barrel member in place of the insert ring.

The step of providing the adapter ring can include the step of modifying the insert ring. The method can include the further steps of:

(a) providing an auxiliary source of pressure air;

(b) fluid-connecting the auxiliary source to an interior cavity portion of the inner barrel member for augmenting the flow of cooling air;

(c) connecting an adjustable valve between the auxiliary source and the inner barrel member for variably restricting air flow from the auxiliary source and the inner barrel member;

(d) monitoring an operating parameter of the power plant; and

(e) adjusting the adjustable valve in response to changes in the operating parameter.

DRAWINGS

These and other features, aspects, and advantages of the present invention will become better understood with reference to the following description, appended claims, and accompanying drawings, where:

Figure 1 is a fragmentary sectional elevational view of a prior art stationary turbine power plant machine;

Figure 2 is a detail sectional view of the prior art machine of Fig. 1 within region 2 thereof;

Figure 3 is a graph showing start-up and shut-down compressor discharge pressure and temperature profiles of the prior art machine of Fig. 1;

Figure 4 is a sectional view as in Fig. 2, showing the machine as improved according to the present invention; and

Figure 5 is a lateral sectional diagrammic view of the machine of Fig. 4.

DESCRIPTION

The present invention is directed to a turbine power plant having improved control of cooling bypass air. With reference to Figs. 1-3 of the drawings, a prior art gas turbine machine 10 has a multi-stage axial compressor 12, a combustor 14, and a turbine 16 that is shaft-coupled to the compressor 12 within an inner barrel member 18, a set of rotor bearings also being mounted within a bearing housing 20 that is located within the barrel member 18. The compressor 12 has a last or seventeenth stage 17R on a rotor member 24, and an associated stator 17S that supportively contacts the inner barrel member 18. A labyrinth seal 22 is

located between the rotor member 24 and the barrel member 18, the seal 22 including a plurality of stationary knife-edge members 26 projecting inwardly from the barrel member 18 toward a series of radially offset cylindrical portions of the rotor member 18. A small annular clearance normally exists between each knife-edge member 26 and the rotor member 18 as indicated by a radial gap distance LD, the distance LD being made approximately 0.030 inch at manufacture. A chamber 28 is formed within the barrel member 18, being supplied with cooling air from the last stage of the compressor 12 by a controlled amount of leakage through the labyrinth seal 22. The cooling air, after passing the rotor bearing housing 20, flows outwardly in front of a first wheel 30 of the turbine 16 and mixes with high-temperature gases passing from the combustor 14 through a nozzle block 31. The barrel member 18 can be segmented, being maintained in alignment by an interlocking insert ring 32 that also supports a final stator member 34 of the compressor 12. Typically, the inner barrel member 18 is formed by a pair of semi-circular segments, the insert ring 32 also being formed in three segments that overlap joints between the segments of the barrel member. The insert ring 32 is axially spaced from a portion of the rotor member 24 by a distance C through which the cooling air flows toward the labyrinth seal 22, the distance C corresponding to a space between the rotor 17R and the stator 17S, the stator 17S also having a width W. The machine 10 under design conditions produces air flow at a pressure of approximately 167 psi gage and a temperature of approximately 675°F at the exit of the compressor 12, the main portion of the flow being between the inner barrel member 18 and an outer barrel member 36 that surrounds the inner barrel member 18. A radially spaced pair of "angel wings" 34 project forwardly toward the compressor 12 from the first wheel 30 for

limiting cooling air flow from the chamber 28 to the turbine 16. The chamber 28 within the inner barrel member 18 is intended to be maintained at a pressure of proximately 82 psi gage by the flow of cooling air through the labyrinth seal 22.

The turbine machine 10, being of the type that is commercially available as Series 7001 heavy duty gas turbine from the previously identified General Electric Corp., has a somewhat protracted start-up sequence that lasts over one hour and a shut-down sequence that lasts approximately one hour as characterized in Fig. 3 by associated discharge pressures and temperatures of the compressor 12. Figure 3 also includes power loading in megawatts and rotational speed as a percentage of rated speed for the start-up and shut-down sequences, plotted against time. Typically, there is significant wear of the knife edge members 26 against the rotor member 24 during portions of the shut-down sequence from the as manufactured condition, the distance LD rapidly increasing to between approximately 0.070 inch and approximately 0.110 inch. This increased clearance adversely affects performance of the machine 10 by lowering the flow of pressurized air into the combustor 14 as well as excessively lowering the turbine inlet temperature (by mixing the low temperature stream of compressed cooling air with the stream of hot combustion gases from the combustor 14).

According to the present invention, and with further reference to Figs 4 and 5, the machine, designated 10', is provided with a brush seal 40 for augmenting the labyrinth seal 22. The brush seal 40 includes a backing plate 42, a multiplicity of tightly packed bristle members 44, and a cover plate 46. The bristle members 44 are clamped between the backing plate 42 and the cover plate 46,

outer extremities of the bristle members being positively anchored to the plates 24 and 46 by welding or other suitable means. The bristle members 44 are typically very thin, being formed of a high-strength metal alloy, and closely packed at a density of approximately 4,500 per square inch.

In an exemplary configuration of the machine 10′, a retainer plate 48 holds the brush seal 40 in fixed relation to the barrel member 18 by interlocking engagement with a counterpart of the insert ring, designated adapter ring 32′, the backing plate 42 having a generally L-shaped cross-section, one leg of which axially projects into the adapter ring 32′. The retainer plate 48 is fastened to the insert ring 32′ by a plurality of threaded fasteners 50. In the exemplary configuration of Fig. 4, the fasteners 50 are conventional undercut flat head machine screws having a thread diameter of approximately 0.099 inch, being spaced circumferentially not more than 6 inches on center, and staked in place. As further shown in Fig. 4, the bristle members 44 are located in spaced relation to a land region 52 of the rotor member 24, the land region having a diameter D, the bristle members 44 being radially spaced at a distance BD from the land region 52. Thus the brush seal 40 is fluid-connected in series with the labyrinth seal In a "cold" condition of the machine 10′, the distance BD is preferably approximately 0.010 inch for preventing unwanted contact between the bristle members 44 and the rotor member 24. It is contemplated that momentary contact between the bristle members 44 and the rotor member 24 may occur during the shut-down sequence as explained above, but that no such contact will occur either during the initial portion of the start-up sequence or during steady-state full load operation of the machine 10′. It is believed that the preferred

avoidance of continuous brush contact is attained when the "cold" clearance (with the rotor member 18 stationary) is not less than 0.015 percent of the diameter D. In the case of the "Frame-7 machine", the diameter D is approximately 50.5 inches; accordingly, the distance BD is preferably not less than 0.00757 inch, being more preferably approximately 0.010 inch. In the "cold" condition, the backing plate 42 is radially spaced at a distance BB from the rotor member 24, the distance BB being sufficiently great for preventing contact withe the rotor member, yet sufficiently small for supporting the bristle members 44 against upstream air pressure. In the above example, a preferred value for the distance BB is approximately 0.170 inch. The backing plate 42 is also tapered inwardly and forwardly for fail-safe limitation of rotor contact in the event of abnormal operating conditions. Under design conditions, the clearance distance BD is contemplated to be somewhat less than in the cold condition in which the machine 10' is characterized, but not so much less as to create contact. If testing shows otherwise, the clearance distance BD is preferably to be made slightly larger.

It is contemplated that the brush seal 40 be added to existing turbine machines 10 having worn labyrinth seals 22 as described above. In the present invention this facilitated by the need for modification of the insert ring 32 only. Particularly, the adapter ring 32' can be formed by axially shortening the existing insert ring 32, forming an annular channel as indicated at 54, and forming threaded openings 56 for the fasteners 50. The adapter ring 32' can be segmented as described above in connection with the insert ring 32.

It is also contemplated that the brush seal 40 be used in "fresh" installations having no wear of the

labyrinth seal 22. In such cases, the labyrinth seal radial spacing LD, which is only 0.03 inch, quickly increases as a result of wear during shut-down as described above. Nevertheless, it may be desired to augment the flow of cooling air into the chamber 28. Accordingly, and as shown in Fig. 4, the barrel member 18 is preferably provided with one or more threaded passages 60. Selected ones of the passages 60 are closed or partially blocked by respective plugs 62 and/or jets 64.

Also, some or all of the passages 60 can be fluid-connected to an auxiliary source 66 of pressure air as shown In Fig. 5. More particularly, the outer barrel member 36 of the turbine machine 10 is provided with one or more fluid ports 70, an inner conduit 72 being fluid-connected between each port 70 and a corresponding one of the threaded passages 60, an outer conduit 74 being fluid-connected between the port(s) 70 and the auxiliary source 66 and having an adjustable valve 76 series-connected therein for adjustably restricting the flow of auxiliary cooling air into the chamber 28 of the inner barrel member. Preferably the valve 76 is a calibrated needle valve for facilitating repeatable adjustment thereof in response to a monitored operating parameter of the machine 10. The monitored operating parameter can be an inside temperature of the inner barrel member 18, which grows to exceed a preferred value if the brush seal 40 is excessively effective in restricting the flow of cooling air from the compressor 12 into the chamber 28. Figure 5 shows a thermocouple temperature sensor 78 that is normally provided with the machine 10 of Figs. 1-3, the sensor 78 having a conventional indicator 80 associated therewith. Manual control of the needle valve 76 in response to readings of the indicator is appropriate in that the start-up sequence of Fig. 3 is

sufficiently slow. The auxiliary source 66 must be maintained at greater pressure than that of the chamber 28 for assuring the proper direction of flow. It will be understood that at least a portion of the auxiliary source 66 can be provided by the compressor 12. Indeed, when any of the passages 60 are left open or provided with jets 64, but not the inner and outer conduits 72 and 74, that portion of the auxiliary source 66 is the last stage of the compressor 12. Also, it may be preferred to take from an earlier stage of the compressor 12, or from an independent source, to provide the auxiliary source 66 for reasons of greater efficiency and/or reduced cost.

The turbine machine 10′ of the present invention provides improved control of cooling air into the chamber 28 for significantly increased output and efficiency in typical large power plant installations. Under conditions presently encountered, it is believed that the present invention will provide approximately 1.5 megawatts of additional power output from a typical installation of the Frame-7 machine, resulting in a savings on the order of $250,000 per machine, the installation cost being on the order of $30,000.

Although the present invention has been described in considerable detail with reference to certain preferred versions thereof, other versions are possible. Therefore, the spirit and scope of the appended claims should not necessarily be limited to the description of the preferred versions contained herein.

What is claimed is:

1. A stationary gas turbine engine for a power plant, comprising:

(a) a multistage axial compressor, the compressor having a rotor, the rotor having a cylindrical land region downstream of a last-stage of the compressor, the land region having an outside diameter D;

(b) a turbine shaft-coupled to the rotor of the compressor;

(c) a combustor fluid coupled between the compressor and the turbine;

(d) a stationary inner barrel member downsttream of the compressor, air flowing from the compressor to the combustor passing outside of the inner barrel member, a chamber within the inner barrel member forming a passage for cooling air from the compressor, the cooling air flowing from the chamber and being mixed with combustion gases upstream of the turbine;

(e) a brush seal for restricting air passage into the chamber from the compressor, the brush seal comprising:

(i) a ring-shaped holder;

(ii) a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder; and

(iii) means for fastening the holder to the inner barrel member,

wherein, when the power plant is inactive, the bristles have an ambient temperature clearance of not less than 0.015 percent of the diameter D from the land region of the rotor.

2. The engine of claim 1, further comprising means for selectively altering the flow of cooling air from the chamber, comprising:

(a) a passage extending through one wall of the inner barrel;

(b) means for connecting the fluid port to an auxiliary source of pressure air external of the inner barrel, whereby pressure air from the auxiliary source augments the flow of cooling air from the chamber; and

(c) means for changeably restricting flow of pressure air into the chamber from the auxiliary source of pressure air.

3. The engine of claim 2, wherein the compressor provides at least a portion of the auxiliary source.

4. The engine of claim 3, wherein the means for changeably restricting comprises means for removably mounting a device in the passage, the device being selected from the set consisting of a plug and a jet.

5. The engine of claim 1, wherein the means for selectively altering further comprises:

(a) a valve for adjustably restricting flow of pressure air into the chamber from the auxiliary source of pressure air; and

(b) means for monitoring an operating parameter of the engine, the operating parameter being responsive to the flow of cooling air from the chamber.

6. The engine of claim 5, wherein the valve is a calibrated needle valve.

7. The engine of claim 5, wherein the means for monitoring comprises a temperature sensor for indicating a temperature within the chamber.

8. The engine of claim 5, further comprising an outer barrel surrounding the inner barrel and having a fluid port extending radially through one wall thereof, the gas flow from the compressor to the combustor passing between the outer barrel and the inner barrel, the means for connecting the fluid port comprising a fluid conduit connected between the passage and the fluid port, and means for connecting the auxiliary source of pressure air to the fluid port external of the outer barrel.

9. The engine of claim 1, further comprising an insert ring connecting segments of the inner barrel member, the insert ring being located proximate the land region of the rotor, wherein the means for fastening the brush seal to the inner barrel member comprises the holder being fastened to the insert ring by a plurality of threaded fasteners.

10. The engine of claim 9, wherein the brush seal, including the holder thereof is segmented for facilitating assembly with the insert ring.

11. In a turbine power plant having a multistage axial compressor, a turbine shaft-coupled to a rotor of the compressor, a combustor fluid-coupled between the compressor and the turbine, and a labyrinth seal between the rotor and a stationary inner barrel member, the rotor having a cylindrical land region of diameter D, the improvement comprising a brush seal connected to the inner barrel and augmenting the labyrinth seal, being fluid connected in series therewith, the brush seal comprising:

(a) a ring-shaped holder;

(b) a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder; and

(c) means for fastening the holder to the inner barrel member,

wherein, when the power plant is inactive, the bristles have an ambient temperature clearance of not less than 0.015 percent of the diameter D from the land region of the rotor.

12. The turbine power plant of claim 11, the further improvement comprising means for selectively altering the flow of cooling air from the chamber, comprising:

(a) a passage extending through one wall of the inner barrel;

(b) means for connecting the passage to an auxiliary source of pressure air external of the inner barrel, whereby pressure air from the auxiliary source augments the flow of cooling air from the chamber;

(c) means for changeably restricting flow of pressure air into the chamber from the auxiliary source of pressure air.

13. In the turbine power plant of claim 11, wherein the means for selectively altering comprises:

(a) a valve for adjustably restricting flow of pressure air into the chamber from the auxiliary source of pressure air; and

(b) means for monitoring an operating parameter of the engine, the operating parameter being responsive to the flow of cooling air from the chamber.

14. In the turbine power plant of claim 13, the further improvement wherein the means for adjustably restricting comprises a calibrated needle valve.

15. In the turbine power plant of claim 13, the further improvement wherein the means for monitoring comprises a temperature sensor for indicating a temperature within the chamber.

16. In the turbine power plant of claim 13, wherein the power plant also having an outer barrel surrounding the inner barrel, the gas flow from the compressor to the combustor passing between the outer barrel and the inner barrel, the further improvement comprising a fluid port extending radially through one wall of the outer barrel, the means for connecting the fluid port comprising a fluid conduit connected between the passage and the fluid port, and means for connecting the auxiliary source of pressure air to the fluid port external of the outer barrel.

17. A method for controlling cooling air flow in a turbine power plant having a multistage axial compressor, a turbine shaft-coupled to a rotor of the compressor, a combustor fluid coupled between the compressor and the turbine, and a labyrinth seal between the rotor and a stationary inner barrel member, the rotor having a cylindrical land region of diameter D, comprising the steps of:

(a) providing a brush seal having a ring-shaped holder, a multiplicity of bristle members extending radially inwardly from the holder toward the land region of the rotor, outer extremities of the bristle members being rigidly retained relative to the holder;

(b) connecting the brush seal in augmenting relation to the labyrinth seal; and

(c) spacing the bristle members from the land region of the rotor by an ambient temperature clearance of not less than 0.015 percent of the diameter D when the power plant is inactive.

18. The method of claim 17, wherein the power plant includes an insert ring fastened to the inner barrel member in axially spaced relation to a portion of the rotor member, the method comprising the further steps of:

(a) removing the insert ring from the inner barrel member;

(b) providing an adapter ring;

(c) mounting the brush seal to the adapter ring; and

(d) fastening the adapter ring to the inner barrel member in place of the insert ring.

19. The method of claim 18, wherein the step of providing the adapter ring comprises the step of modifying the insert ring.

20. The method of claim 17, comprising the further steps of:

(a) providing an auxiliary source of pressure air;

(b) fluid-connecting the auxiliary source to an interior cavity portion of the inner barrel member for augmenting the flow of cooling air;

(c) connecting an adjustable valve between the auxiliary source and the inner barrel member for variably restricting air flow from the auxiliary source and the inner barrel member;

(d) monitoring an operating parameter of the power plant; and

(e) adjusting the adjustable valve in response to changes in the operating parameter.

ABSTRACT

A stationary gas turbine engine includes an axial compressor; a turbine; a stationary inner barrel downstream of the compressor; a brush seal including a ring-shaped holder supported by the inner barrel, and a multiplicity of inwardly extending bristle members having an ambient temperature clearance of not less than 0.015 percent of a rotor land region diameter of the rotor under cold conditions for restricting air passage into the chamber from the compressor. The flow of cooling air from the chamber is preferably alterable by a fluid port extending through one wall of the inner barrel, the fluid port being connected to an auxiliary source of pressure air external of the inner barrel, whereby pressure air from the auxiliary source augments the flow of cooling air from the chamber. A calibrated needle valve can adjustably restrict the flow of auxiliary air for controlling a monitored operating parameter such as the temperature within the chamber. The engine can have an outer barrel surrounding the inner barrel, air flowing therebetween toward the combustor, and including a radial fluid port, and a fluid conduit connected between the passage and the fluid port, the auxiliary source being connected to the fluid port external of the outer barrel. A method for controlling cooling air flow in the power plant includes providing the brush seal; connecting the brush seal in augmenting relation to the labyrinth seal; and spacing the bristles from the land region of the rotor.

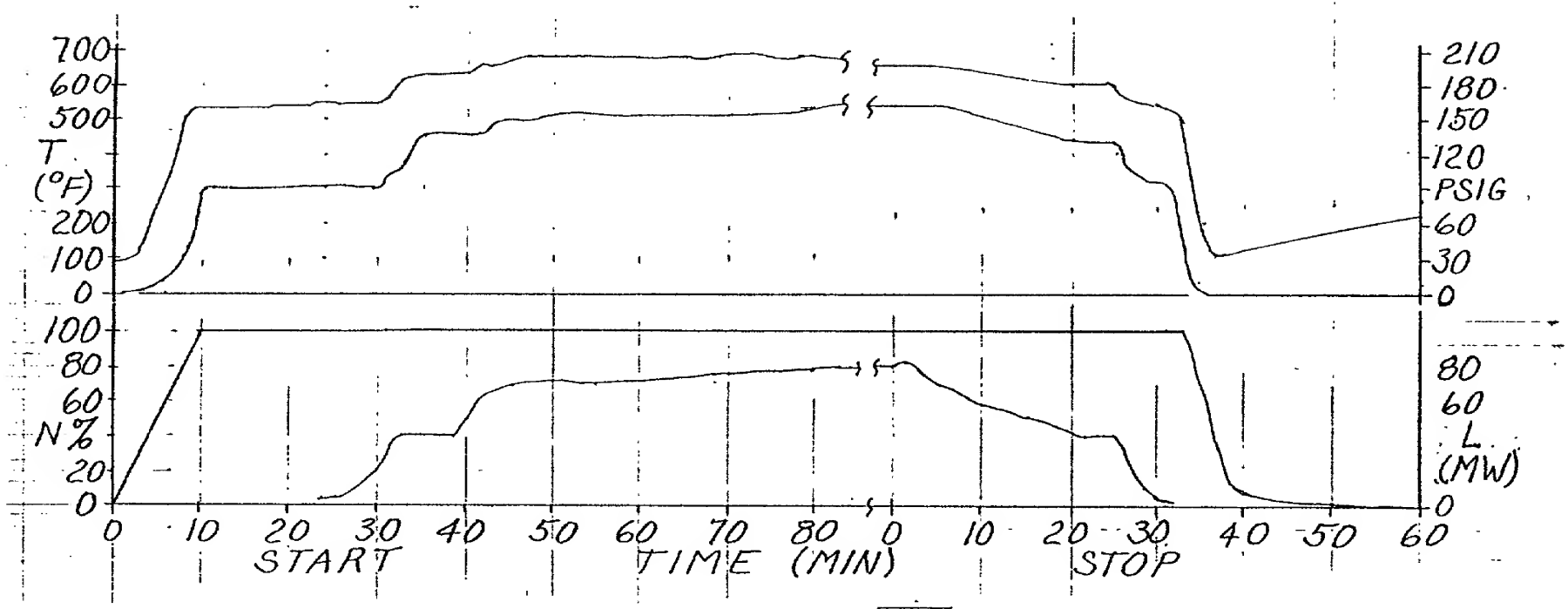


FIG 3

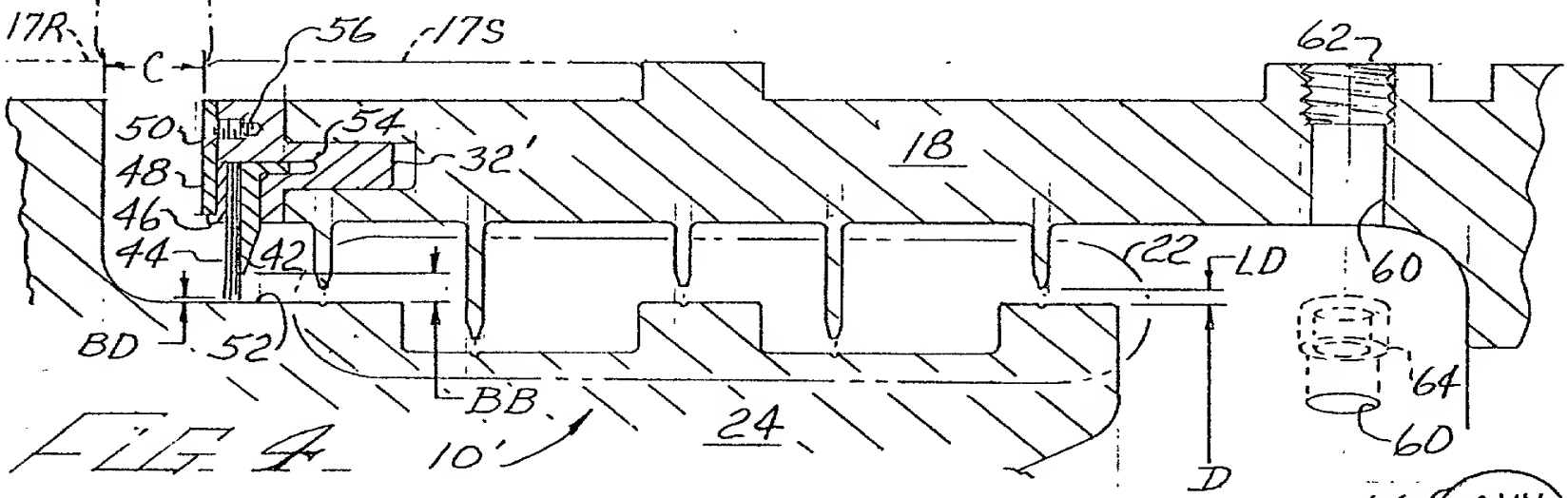


FIG 4

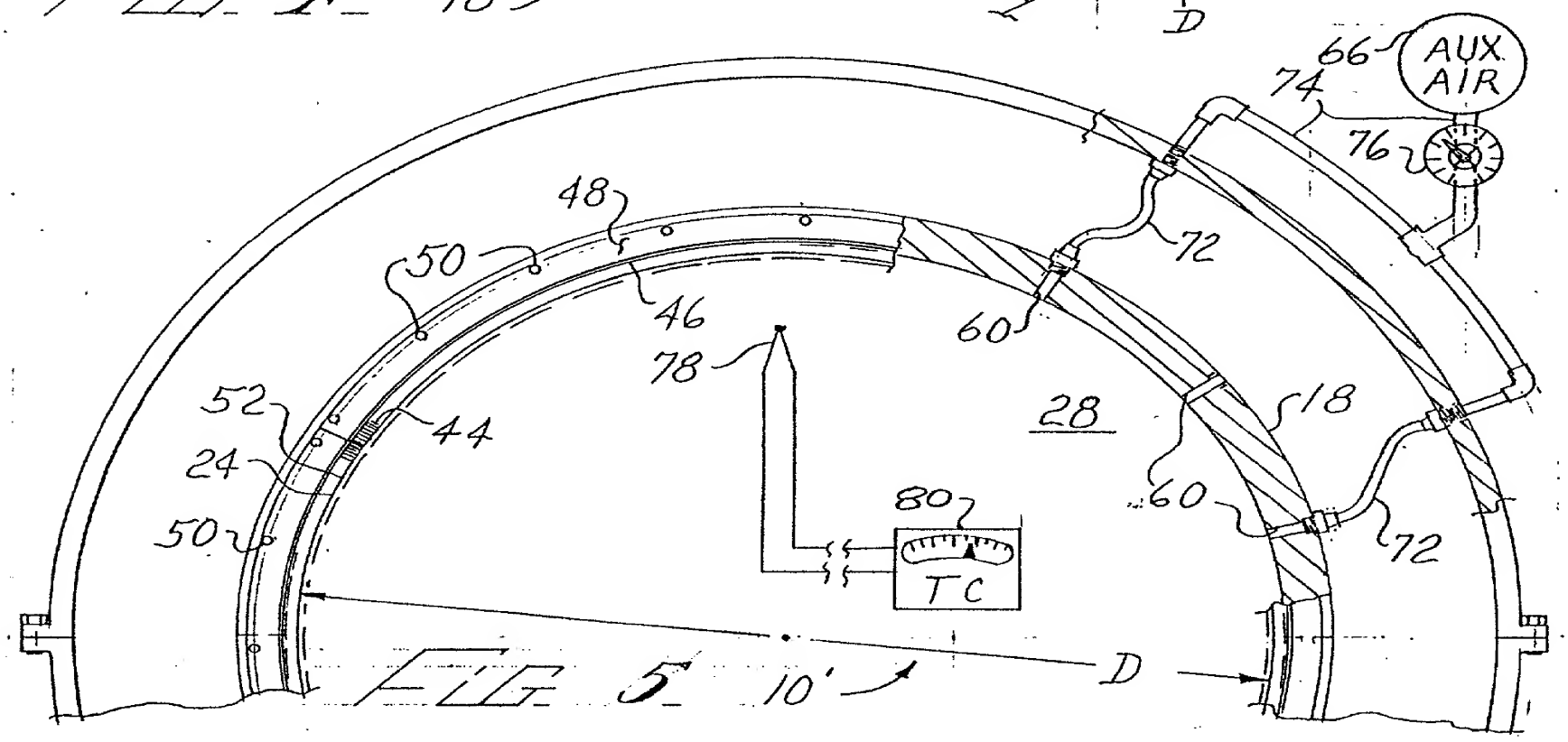


FIG 5

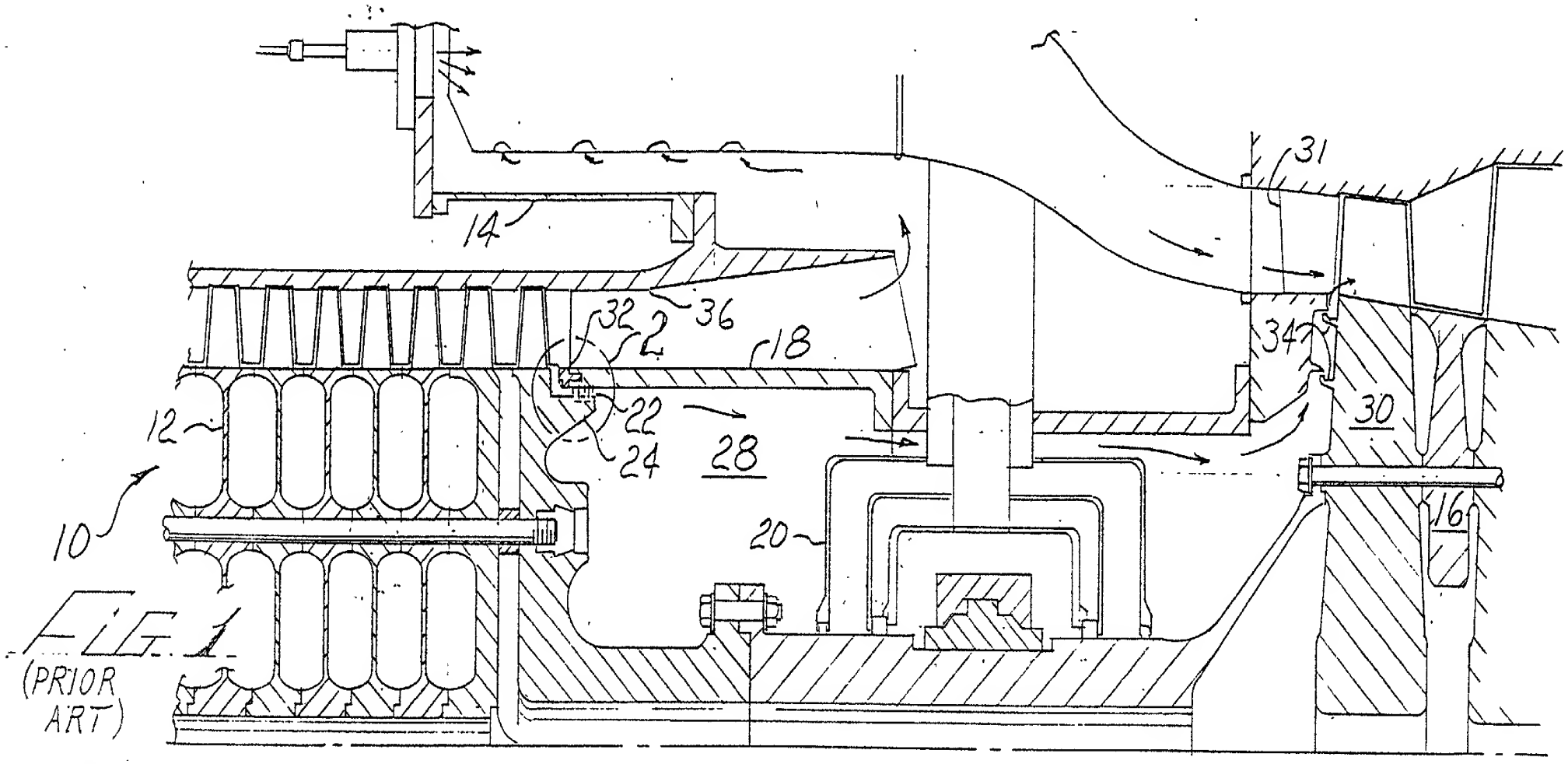
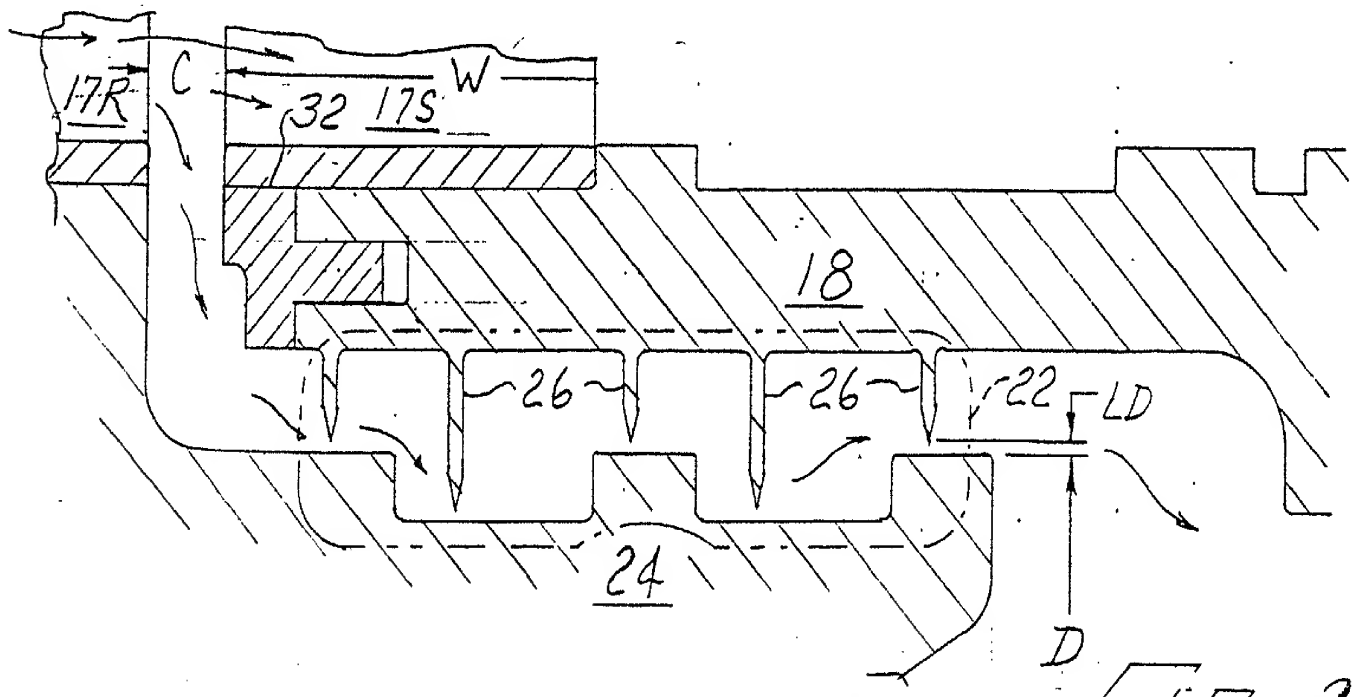


FIG. 1
(PRIOR ART)



(PRIOR ART) FIG. 2

DECLARATION

Utility Application

DOCKET INFORMATION
11465

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL, the specification of which

Check One

- ☐ is attached hereto.
- ☒ was filed on May 31, 1996 as Application Serial No. 08/656,564 and was amended on _____ (if applicable).

I have read the applicable statutes and rules reprinted on the reverse side of this declaration which I understand to describe subject matter which is material under 37 CFR § 1.56(a).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a). I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Application Number	Country	Date of Filing	Priority Claimed Yes✓	Priority Claimed No✓
NONE				

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

Application Number	Date of Filing	Status — Patented, Pending or Abandoned
NONE		

A. 'LICABLE STATUTES AND I. .LES

37 CFR § 1.56 DUTY OF DISCLOSURE; FRAUD; STRIKING OR REJECTION OF APPLICATIONS.

(a) . . . Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. . . . The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. . . .

Information relating to the following factual situations enumerated in 35 USC § 102 and § 103 below should be considered material under 37 CFR § 1.56(a).

35 U.S.C. § 102. CONDITIONS FOR PATENTABILITY; NOVELTY AND LOSS OF RIGHT TO PATENT.

A person shall be entitled to a patent unless —

(a) The invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or

(c) he has abandoned the invention, or

(d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the application for patent, or

(f) he did not himself invent the subject matter sought to be patented, or

(g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of the invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

35 U.S.C. § 103. CONDITIONS FOR PATENTABILITY; NON-OBVIOUS SUBJECT MATTER.

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

35 U.S.C. § 119. BENEFIT OF EARLIER FILING DATE IN FOREIGN COUNTRY; RIGHT OF PRIORITY (Applicable Portion)

An application for patent for an invention filed in this country by any person who has, or whose legal representatives or assigns have, previously regularly filed an application for a patent for the same invention in a foreign country which affords similar privileges shall have the same effect as the same application would have if filed in this country on the date on which the application for patent for the same invention was first filed in such foreign country, if the application in this country is filed within twelve months from the earliest date on which such foreign application was filed; but no patent shall be granted on application for patent for an invention which has been patented or described in a printed publication in any country more than one year before the date of the actual filing of the application in this country, or which had been in public use or on sale in this country more than one year prior to such filing.

35 U.S.C. § 120. BENEFIT OF EARLIER FILING DATE IN THE UNITED STATES.

An application for patent for an invention disclosed in the manner provided by the first paragraph of section 112 of this title in an application previously filed in the United States, or as provided by section 363 of this title, by the same invention shall have the same effect, as to such invention, as though filed on the date of the prior application, if filed before the patenting or abandonment of or termination of proceedings on the first application or on an application similarly entitled to the benefit of the filing date of the first application and if it contains or is amended to contain a specific reference to the earlier filed application.

35 U.S.C. § 112. SPECIFICATION (Applicable Portion)

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the use the same, and shall set forth the best mode contemplated by the inventor by carrying out his invention.

The specification shall conclude with one or more claims particularly pointing out and distinctively claiming the subject matter which the application regards as his invention.

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	RESIDENCE & CITIZENSHIP	City	State or Foreign Country	Country of Citizenship	
	POST OFFICE ADDRESS	Post Office Address	City	State or Country	Zip Code

I further declare that all statements made herein of my own knowledge are true that all statements made on information and believe are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor
201
×
Date × 7/24/96

Signature of Inventor
204
Date

Signature of Inventor
202
Date

Signature of Inventor
205
Date

Signature of Inventor
203
Date

Signature of Inventor
206
Date

(Signatures should conform to names as presented at 201 *et seq.* above.)

DOCKET NO.: ARCO-25,195; DP 50-06-1641B

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Steve Ingistov
Serial No. :	08/892,738
Filed:	July 15, 1997
Group Art Unit:	3401
Examiner:	J. Kwon
Title :	TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

REVOCATION AND POWER OF ATTORNEY

Watson Cogeneration Company is the assignee of the entire right, title and interest in the subject application by an assignment recorded August 1, 1996 at Reel 8093, Frame 0212.

The undersigned authorized representative of the Assignee of the entire interest in the above-identified patent application hereby revokes all previous powers of attorney given in said application and appoints Albert C. Metrailer, Registration No. 22,714; Steven J. Funk, Registration No. 35,875; John L. Wood, Registration No. 32,183; Rodney B. Carroll, Registration No. 39,624; and F. Lindsey Scott, Registration No. 26,230, as attorneys with full power of substitution and revocation to prosecute said application and transact all business in the Patent and Trademark Office in connection with said application and to receive any patent issuing thereon.

Please address all further correspondence regarding said application to:

Law Offices of F. Lindsey Scott
14651 Dallas Parkway, Suite 102
Dallas, Texas 75240-7477
972-661-0102.

Respectfully submitted,

WATSON COGENERATION COMPANY

Patrick L. King
Executive Director
Watson Cogeneration Company

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DOCKET NO.: ARCO-25,195; DP 50-06-1641B

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Steve Ingistov

Serial No. : 08/892,738

Filed: July 15, 1997

Group Art Unit: 3401

Examiner: J. Kwon

Title : TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

APPOINTMENT OF ASSOCIATE ATTORNEY

The undersigned principal attorney in the subject application hereby appoints Michael W. Piper, Registration No. 39,800 as associate attorney in the subject application with full authority to prosecute the application and transact all business in the Patent and Trademark Office in connection with the application and to receive any patent issuing thereon.

Please address all future correspondence to:

Law Office of F. Lindsey Scott
14651 Dallas Parkway, Suite 102
Dallas, Texas 75240-7477
972-661-0102.

Respectfully submitted,

F. Lindsey Scott
Registration No. 26,230
Attorney for Applicant

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POWER OF ATTORNEY

DOCKET INFORMATION
11465

Watson Cogeneration Company, owner(s) of the application for United States Letters Patent for an improvement in TURBINE POWER PLANT HAVING MINIMAL-CONTACT BRUSH SEAL AUGMENTED LABYRINTH SEAL,
by Steve Ingistov

- ☐ executed on even date herewith or
- ☒ having Serial No. 08/656,564, filed May 31, 19 96,

do(es) hereby appoint as attorneys of record with full power of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Jeffrey G. Sheldon, Reg. No. 27,953; Stephen R. Seccombe, Reg. No. 31,136; Danton K. Mak, Reg. No. 31,695; and Denton L. Anderson, Reg. 30,153.

Send Correspondence to:	Sheldon & Mak 290 N. D St., Ste. 503 San Bernardino, CA 92401	Direct Telephone Calls to: Stephen R. Seccombe (909) 889-3649

I the undersigned, declare that I am the (an) owner of the above-identified application, or if the owner is a corporation, partnership or other association, I am authorized to make this appointment on behalf of the owner, and I further declare that all statements made herein of my own knowledge are true and that all statements made on information and believe are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

	Full Name of Individual Owner	
	Post Office Address	
	Signature of Owner	Date

	Full Name of Declarant If owner is corporation, partnership or association Thomas F. Daniels	
	Title of Declarant Executive Director	
	Address of Declarant 22850 S. Wilmington Avenue, Carson, California 90745	
	Signature of Declarant x Thomas F. Daniels	Date x July 25, 1996